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Exploring methods for an emerging research field

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Exploring methods for an emerging research field

by

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Key words

sustainability transitions, transformation, transformative research, transformation research, sustainability

Abstract

The last years, calls surged for a transformation research, which addresses the increasing global environmental and social challenges and supports transformations towards sustainability. As transformation research developed rapidly in relation to various societal domains and established research strands, there is currently a need for self-reflection with regard to empirical and theoretical concepts, foci and frameworks. Especially the far-reaching ambitions of transformation research, namely to contribute actively to societal change processes towards sustainability, are controversially debated and need a critical reflection of research approaches and methods.

This working paper contributes to the ongoing discussion about transformation research. We argue that transformation research is not (yet) an established research field, but an emerging research perspective that joins together different research streams focusing on societal change towards sustainability. We analyse the goals, contents, results and research approaches of this perspective as well as its social science methods. A specific focus of this paper is on the description and analysis of suitable methods for transformation research. We analyse social-science methods with regard to their contributions to the goals, results and research foci of transformation research as well as their use in descriptive-analytical and transformative research approaches.

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1 Introduction

In recent years, ‘transformation research’ has gained increasing attention as a lens to study and scientifically support societal change with the goal to contribute to effective, equitable and durable solutions to some of today’s most urgent problems (WBGU 2011, Haum and Pilardeaux 2014, O’Riordan and Le Quère 2013, Future Earth 2014, Patterson et al. 2015). In light of converging and persistent social, ecological and economic problems and crises, numerous actors in political and scientific discourses in Germany, Europe and worldwide advocate fundamental societal change as indispensable for moving towards sustainability (IPCC 2014, UNEP 2012, WBGU 2011, Steffens et al. 2015). A sustainability transformation involves structural and paradigmatic changes in societies – including cultures, values, technologies, production, consumption, infrastructures and politics (Grießhammer and Brohmann 2015, Loorbach 2014). It is described as a societal searching and learning process; such a process includes a diversity of actors from different societal spheres (government, market, civil society), who jointly learn about existing challenges and their root causes, explore social, technical and institutional innovations and change their behaviours (Hoffmann et al. 2007). Transformation research is ascribed a central role in structuring and facilitating societal learning processes (Haum and Pilardeaux 2014). For example, the German Advisory Council on Global Change (WBGU) recommends to establish transformation research as “*a new scientific discipline, [...] which specifically addresses the future challenges of transformation realisation*” (WBGU 2011: 22).

The rapid development of transformation research in the past years left little room for self-reflection on empirical and theoretical foci, frameworks and suitable research methods as well as on how these (can) relate to the goals and results of transformation research. It is particularly difficult to more precisely grasp transformation research because it joins many societal issues (e.g. economy, consumption, mobility, energy) as well as a variety of research strands that are (partially) concerned with the exploration and navigation of fundamental structural change processes towards sustainability. These include, for example, sustainability science (Kates et al. 2001, Miller et al. 2014, Wiek et al. 2012), transition studies (Markard et al. 2012, Grin et al. 2010, Loorbach et al. 2015), resilience research (Folke et al. 2010, Olsson et al. 2014) and social innovation (Franz et al. 2012, Westley et al. 2013) as well as individual publications from sociology, political science, future studies and psychology (Haum and Pilardeaux 2014, Heyen and Brohmann 2017, Patterson et al. 2015). Transformation research is emerging as conceptual glue between these strands. However, integrating the different bodies of knowledge, requires to make the different conceptual entry points explicit.

Particularly, it must be made explicit what the contribution of transformation research actually is in light of its explicit orientation towards contributing to societal change. The implied new role for research and science is fervently debated. Proponents of such a role for transformation research – such as research funding and research policy institutions and think tanks – highlight the need for knowledge that is oriented towards understanding and addressing societal problems hindering sustainability. Research can, for example, generate a better understanding of (historical) societal change processes, develop innovative solutions and engage with stakeholders in the co-design and co-production of solutions-oriented knowledge by building on transdisciplinary and transformative research approaches (Grunwald 2015, Schneidewind 2015b, Rohe 2015, von Wissel 2015, Ober and Paulick-Thiel 2015). Main criticisms include the implied dedifferentiation between society and research that threaten to reduce both the autonomy of research and democratic principles, the underlying normativity of transformation research and the emphasis of actionable over conceptual knowledge (Stock 2014, Strohschneider 2014).

This paper, which synthesises a more elaborate report (Wittmayer and Hölscher 2017), aims to contribute to the debate about transformation research as an emerging research field with a focus on suitable social science methods. We develop a working definition of transformation research as a research perspective, its goals and results (section 2.1), research approaches and quality criteria (section 2.2)

and research foci (section 2.3). In particular, we provide an overview of social science methods that are applied in transformation research projects (section 3.1) and analyse their contribution to the goals, research foci and intended results of transformation research as well as their relationship to the research approaches (section 3.2). Research methods play a central role in knowledge production processes. The complexity of the empirical unsustainability challenges and problems addressed by transformation research as well as the ambition to develop concrete solutions demand a critical reflection about methods and how these support a sound and solution-oriented research and societal learning. The analysis of methods helps to relate the largely theoretical debates to the actual research practice. This enables to discuss the specific contribution of methods and to identify needs and gaps in the way methods are applied in transformation research practice (section 4). In our conclusion, we identify overarching discussion points to further advance transformation research (section 5).

This paper was developed in the context of a study for the German Environmental Agency with the objective to structure the debates about transformation research and to gain an overview of suitable social science methods (Wittmayer and Hölscher 2017). To this end, we did a literature analysis of German publications focusing on transformation research or transformative research and of English publication of scientific strands focusing on researching and addressing fundamental societal change processes towards sustainability (namely transition research, social-ecological or sustainability research, social innovation research and resilience research). We complemented this literature review with four expert interviews and an international expert workshop held in Berlin in June 2016. Specifically for the overview of social science methods and their applications, we analysed five German and five European research projects related to sustainability transformations in depth¹. We identified relevant projects by screening diverse project data bases (German: FONA, Ufordat; Dutch: NWO, Narcis) and selecting European research projects funded under FP 6 and FP 7. We selected the projects based on the following criteria: relation to transformation, transition, sustainability (necessary condition) and to social innovation, mainstreaming, niche (optional condition). In addition, we sought to ensure a diversity of methods, research institutes and topics across the projects, and selected projects that started after January 1, 2010, and provided sufficient information for our research.

2 Introducing transformation research as a research perspective

A research field can be delineated by its focus on a specific cognitive problem and by a basic consensus on how to analytically approach this problem (Cole 1983, cf. Markard et al. 2012). In this section, we introduce transformation research as a joint research perspective to study complex and pervasive societal problems and to search and support long-term and fundamental societal change processes and dynamics towards sustainability (WBGU 2011). As such, transformation research does not (yet) constitute a closed research field, but rather brings together insights, frameworks and approaches from a diversity of research strands (Patterson et al. 2015, Haum and Pilardeaux 2014, Heyen and Brohmann 2017).

Based on our literature review we derived the following definition of transformation research, which describes the research perspective in all these research strands (working definition):

Transformation research studies and supports fundamental change processes of societal systems towards sustainability from a scientific perspective. These research goals require both descriptive-analytical as well as transformative research approaches, which yield

¹ This selection included the following 10 projects: ARTS (Accelerating and Rescaling Transitions); CASI (Public Participation in Developing a Common Framework for Assessment and Management of Sustainable Innovation); InContext (Individuals in context); SIMPACT (social innovation, economic foundation, empowering people); TRAPESES (Transition Patterns Enabling Smart Energy Systems); Nachhaltiger Konsum durch soziale Innovation (Sustainable consumption through social innovation); Soziale Innovationen in Deutschland (social innovation in Germany); Foodlinks; ELaN ([Development of integrated land management through sustainable use of water and resources in North-East-Germany); In Zukunft eine klimaverträgliche Gesellschaft (A climate-resilient society in the future).

conceptual and actionable knowledge through trustworthy, transparent and reflexive research processes. The – complementary – research foci of transformation research include the objects of transformation (what changes over the course of a transformation), the change dynamics of transformation processes and emerging transformation pathways (how do transformation processes occur), and the drivers of transformation processes (by whom/how are transformation processes supported).

In the following, we substantiate the different elements of our working definition: the goals and results, the research approaches and quality criteria, and the research foci of transformation research.

We zoom in on four research strands related to transformation research and on how they address questions regarding sustainability transformations: transition research, social-ecological or sustainability research, social innovation research and resilience research. Not all research strands are explicitly or exclusively concerned with fundamental societal change. For example, (parts of) resilience research and sustainability science only recently took up the notion of sustainability transformations (Olsson et al. 2014, Wiek et al. 2012). Similarly, only a specific subset of the research on social innovation focuses on its relation with transformative change (Westley et al. 2013, Haxeltine et al. 2016, Avelino et al. forthcoming). By contrast, sustainability transition research developed explicitly to study transitions in societal systems (Rotmans et al. 2001, Grin et al. 2010, Markard et al. 2012). However, transformation research is broader than transition research; the latter focuses on structural change in societal (e.g. socio-technical and socio-economic) (sub-)systems, but largely neglects ecological dynamics (Smith and Stirling 2010, Olsson et al. 2014). Transformation research can hence serve as catchment basin and integrator of diverse angles on societal change towards sustainability (Patterson et al. 2015). Several scholars discuss convergence points between, for example resilience and transition research (Olsson et al. 2014, van der Brugge and van Raak 2007, Foxon et al. 2009, Smith and Stirling 2010, Pereira et al. 2015).

While transformation as a kind of change is generally conceived of as fundamental and radical, what precisely the implications of this ‘radicality’ are remains ambiguous (Wittmayer and Hölscher 2016). Relatedly, scholars and research fields employ both ‘transformation’ and ‘transition’ in what appears to be mostly interchangeably.² Transformations (and transitions) feature several generic characteristics. For example, they can be intentional or unintentional as well as desirable and undesirable (Grießhammer and Brohmann 2015). In this regard, the normative sustainability orientation is key to assess what kind of change is to be supported or avoided (Loorbach et al. 2015, Frantzeskaki et al. 2012, Wiek et al. 2012) - also with the difficulty that sustainability as an overarching guiding principle is not uniformly interpreted.

2.1 Research goals and results

As current challenges and crises resonate complex interdependencies between cause and effect, they are characterised as persistent problems (Rotmans 2005, Schuitmaker 2012). There are no straightforward, simple solutions for these kinds of problems; they are deeply rooted in societal structures, the problems are contested, context-dependent and systemic, their formulation has political and normative implications and they concern multiple actors. Such an understanding of societal crises as multi-layered, connected problems suggests that for their solution fundamental change in the sense of a ‘great transformation’ towards sustainability is needed (WBGU 2011, also referred to as sustainability transition by Rotmans et al. 2001, Grin et al. 2010). Due to their characteristics, persistent prob-

² The WBGU, for example, refers in the German version of its report to “Transformation”, while the title of its English version reads “World in Transition” (WBGU 2011) – though the German language knows both terms, too. Loorbach (2014), following Polanyi’s notion of a ‘Great Transformation’ describes the great transformation of the industrialisation as a family of sectoral transitions. Some scholars sought to clarify the difference between both terms (Brand 2014, Stirling 2014), but especially transition scholars might not agree with their understandings of transitions as resembling more intentionally and top-down steered kinds of change.

lems cannot be addressed through project or programme management approaches. In this sense, sustainability transformations are considered as societal searching and learning processes, in which a variety of actors collaborate and communicate in search for solutions upon which they continuously reflect (Haum and Pilardeaux 2014, Grin et al. 2010, Hoffmann et al. 2007). This discussion led to the call for research focusing on such sustainability transformations and accords research a role in the challenge of influencing change dynamics towards sustainability (WBGU 2011, Schneidewind 2015a, Future Earth 2014).

Different research strands have taken up this call and consider their research **goals** as two-fold: on the one hand, it is dealing with transformations as research object – analysing, describing and explaining historical transformations and current change dynamics to increase our understanding of them as a knowledge base to support transformations towards sustainability. On the other hand, it is about actively supporting such sustainability transformations. In light of the latter goal, next to a descriptive modus, different research strands also include a ‘transformative’ or ‘transformational’ research approach (see section 2.2., cf. WBGU 2011, Olsson et al. 2014; Wiek et al. 2012, Loorbach 2014, Haum and Pilardeaux 2014).

To attain these goals, research activities produce certain **knowledge results**. There are different suggestions with regards to the kinds of knowledge that should be created. The WBGU (2011: 341) suggests that transformation research needs to create systemic, reflexive and anticipatory knowledge. These resemble the distinction between system, target and transformation knowledge of transdisciplinary research (see Pohl et al. 2008). These distinctions are oriented along different *content-related* components and knowledge needs in relation to a sustainability transformation. A different way to structure knowledge gains origins from the action research tradition, which aims to address societal problems by creating scientific and social knowledge as well as transformative action through collaboration with societal actors (e.g. Greenwood and Levin 2007). This distinction thus focuses on the *intended use* of a specific kind of knowledge. With our focus on the description and analysis of methods in relation to their contribution to the goals of transformation research, we are mainly interested in outlining methods, which contribute to the goal of describing, analysing, explaining, evaluating and supporting sustainability transformations. We therefore build on the distinction brought forth in the action research tradition and differentiate between conceptual and actionable knowledge.

Conceptual knowledge allows describing, explaining and understanding systems, transformation dynamics and processes from different disciplinary perspectives. It refers to abstract, universal knowledge (along Aristotele’s understanding of episteme and techné) from natural and social sciences and to contextualised, localised knowledge from social sciences and the humanities. Conceptual knowledge is the main results of descriptive-analytical research approaches, but can also be a result of transformative methods (see section 2.2.). Tangibly, it results in insights, heuristics and/or rules packaged in publications, speeches, and presentations for a scientific or other public, research reports, policy recommendations or interviews. Other outcomes are the further development of concepts or the translation into actions by third parties.

Actionable (or usable) knowledge allows actors to evaluate different options and to decide how to act in specific contexts (cf. Bartels 2012, Bartels and Wittmayer 2014, Cook and Wagenaar 2012). It addresses normative, operational and strategic questions with regards to a (formulated) solution direction. Actionable knowledge is often implicit knowledge of actors, which is made explicit and productive through a research process. Rather than ‘transferred’, this knowledge is “*emerging from creative interactions with others*” (Bartels 2012: 435). Similar conceptions are outlined by action research with the ambition to produce next to scientific also social knowledge (Greenwood and Levin 2007) and by Flyvbjerg and colleagues (2012: 1), who see the role of phronetic social sciences as “*dedicated to enhancing a socially relevant form of knowledge, that is, ‘phronesis’ (practical wisdom on how to address and act on social problems in a particular context)*”. As such, actionable knowledge relates to capacity development and empowerment and is not necessarily built in scientific knowledge in the first place,

rather it is of a different kind. It is the main result of a transformative research approach where researchers pursue a practice-oriented research and create transdisciplinary spaces for working on societal questions (see section 2.2., Wiek et al. 2012, Wittmayer and Schöpke 2014)

2.2 Cornerstones of transformation research: Research approaches and quality criteria

Based on the formulated goals and results (section 2.1.) and our literature review, a number of cornerstones for the transformation research process can be formulated.

Firstly, transformation research is explicitly **oriented towards studying and addressing pressing societal problems** and relates these to fundamental change such as questions about sustainable energy provision or a sustainable social fabric in light of migration and demographic change (WBGU 2011). Such an explicit (normative) orientation can be found in transition research, resilience studies and sustainability studies (Grin et al. 2010, Kates et al. 2001, Olsson et al. 2014).

Secondly, the persistency of the societal questions at hand necessitates both the involvement of more than one discipline and of societal actors (Nowotny et al. 2003, Wiek et al. 2012, Loorbach et al. 2011, Lang et al. 2012, Greenwood und Levin 2007). As societal problems barely take issue with disciplinary boundaries, the involvement of more than one discipline as well as a collaboration of researchers across disciplines is necessary for a better understanding of transformation processes and possible solutions (WBGU 2011, Haum und Pilardeaux 2014, Avelino 2011). Such **interdisciplinary** work allows comparing and possibly integrating different frameworks and concepts to counter the fragmentation of current research. Working with different societal actors in **transdisciplinary** engagements guarantees knowledge insights, which build on both, scientific and social knowledge, and integrate problem perceptions, solutions, norms and values. Such collaboration increases the legitimacy of, responsibility for and identification with the problem and the solution (Lang et al. 2012: 26). It also corresponds with an understanding of a sustainability transformation as a societal searching and learning process in which different actors play different important and complementary roles (Haum und Pilardeaux 2014, Hoffmann et al. 2007, cf. Loorbach 2007).

With the actual research object (i.e. sustainability transformations) being a normative, complex and subjective concept, and the acknowledgement that knowledge is uncertain and provisional, there is a need for transformation research processes to be **adaptive, interparadigmatic and abductive** (cf. Avelino 2011, Wittmayer 2016, Schwartz-Shea and Yanow 2012, Flyvberg et al. 2012, McGowan et al. 2014). This means that transformation research should be in a position to adapt to changing and shifting problem framings and research circumstances and to take these as a starting point rather than as something that needs to be controlled.

Thirdly, in German transformation research debates, we find the distinction between transformation research and transformative research, which we consider a distinction between two research approaches (and to which we will refer to as such), namely a more descriptive-analytical and a transformative (or transformational) **research approach** (WBGU 2011, Stock 2014, Strohschneider 2014, Grunwald 2015, Schneidewind 2015b, Rohe 2015, von Wissel 2015). The same distinction between a descriptive-analytical and a transformative, solution-oriented or process-oriented approach can be found in sustainability science (Miller et al. 2014, Wiek et al. 2012, Miller 2013, Wittmayer and Schöpke 2014, Wiek and Lang 2016). These distinctions can be traced back to debates on post-normal science (Funtowicz and Ravetz 1991), or Modus-2 science (Gibbons et al. 1994) at the end of the last century. Action research is an even more mature approach, which is fully dedicated to societal change: *“We believe that valid social knowledge can only be derived from practical reasoning engaged in through action. As action researchers, we believe that action is the only sensible way to generate and test new knowledge”* (Greenwood and Levin 2007: 6). We suggest that both, a descriptive-analytical and a transformative research approach, have a place in transformation research. They are two different options for finding answers to the research questions at hand. A **descriptive-analytical approach** focuses on

describing and analysing existing challenges and possible solutions through creating primarily (though not exclusively) conceptual knowledge. A **transformative approach** focuses in first instance on explicating and developing actionable knowledge through a participative and action-oriented research process. These research processes can be considered two extremes – with combinations and cross-overs existing.

As a final cornerstone, we turn to **quality criteria** for transformation research. The advancement of research approaches, which further blur the boundaries between society and science, make the inadequacy of current quality criteria apparent. Inward-focused quality criteria and forms of quality control from dominant research paradigms, such as ‘excellence’, peer reviews or h-indices are not sufficient or constructive for the broader questions of transformation research or the specific challenges (e.g. normativity³) it encounters. There are discussions with regards to the necessity of ‘general’ quality criteria. While Nowotny et al. (2003: 187-188) argue that “*clear and unchallengeable criteria by which to determine quality may no longer be available*” and that “*we must learn to live with multiple definitions of quality*”, others are convinced of the need for more generalised quality criteria for transdisciplinary research approaches (vgl. Schneidewind and Singer Brodowski 2013, Bergmann et al. 2005, 2010). Based on discussions in transdisciplinary research, action research sustainability science, we suggest to focus on five general requirement along which to discuss the quality of transformation research. These are particularly fit to also deal with transformative approaches and are outlined in Table 1. Along with Nowotny et al. (2003), we understand these provisional. However, they should be productive in judging each other’s work and thereby to contribute to a general knowledge building (cf. Schwartz-Shea 2006).

Table 1: Quality criteria for transformation research

Criteria		Explanation
<i>Related to research outcomes</i>		
Scientific impact	<p><i>What is the scientific impact of the research?</i></p> <p><i>Cf. Bergmann et al. 2005, Greenwood and Levin 2007, Pohl et al. 2010, WBGU 2011</i></p>	With one of the research outcomes being conceptual knowledge, there is a clear aim for scientific impact.
Social impact	<p><i>What is the social impact of the research?</i></p> <p><i>Cf. Bergmann et al. 2005, Flyvbjerg et al. 2012, Greenwood and Levin 2007, Loorbach et al. 2011, Scholz and Steiner 2015a</i></p>	<p>With one of the goals being to support sustainability transformations, research should be judged along its social impact.</p> <p>Comparable criteria are workability: how good the initial problem was solved (Greenwood and Levin 2007), salience: how relevant the information is for decision-making bodies and the public (Cash et al. 2002), but also social robustness: how relevant, context sensitive and accessible results are (Nowotny 1999, 2000).</p>

³ As convincingly argued by Grunwald (2015), it is not that transformation research is necessarily more normative than other types of research (such as e.g. engineering). However, it does make its normativity more explicit.

Criteria		Explanation
Trustworthiness	<p><i>How trustworthy is the research and its results?</i></p> <p><i>Cf. Lincoln and Guba 1985, Malkki 2007, Schwartz-Shea 2006, Yanow 2006a, 2006b</i></p>	<p>This question relates to whether or not the research can be trusted. Trustworthiness is established if the steps that a researcher takes to produce research outcomes are systematic and when conclusions are adequately supported by evidence.</p> <p>A comparable criteria is the one for credibility (Greenwood and Levin 2007).</p>
<i>Related to research process</i>		
Transparency	<p><i>How transparent is the researcher about the research?</i></p> <p><i>Cf. Cash et al. 2002, Schwartz-Shea 2006, Schwartz Shea and Yanow 2012</i></p>	<p>Transparency includes the documentation of the research goals, approach, as well as research methods and procedures (e.g. project ambition, resources and constraints, decisions taken). It takes account of changes and adaptations of an abductive research process. Being transparent increases the trustworthiness and also the accountability and legitimacy of the research.</p>
Reflexivity	<p><i>How reflexive is the researcher about the research?</i></p> <p><i>Cf. Avelino 2011, Bergmann et al. 2005, Bradbury and Reason 2003, Finlay 2002a, 2002b, Schwartz-Shea 2006, Stirling 2006, Wittmayer and Schöpke 2014</i></p>	<p>A reflexive practice supports the researcher in a number of aspects: situating and positioning him/herself in the research, exploring the researcher-researched relationship and the co-constitution of research as well as offering social critique and deconstructions of established meanings. It includes introspection, a positioning of oneself as researcher in time and space as well as regarding one's background and normative orientation and a questioning of the ways in which the researcher shapes the research and vice versa. It also includes a critical reflection on the situatedness of the research, the social context and political dimensions as well as possible unintended effects. Rather than navel-gazing, such reflexivity is purposeful and leads to more general insights, interpretations and reflexive actions.</p>

Adapted from Wittmayer 2016

2.3 Research foci

In the following, we discern three research foci of transformation research that serve to shed light on different aspects of transformation – hence, these relate to the content of transformation research. Transformation research is concerned with the objects of change (i.e. *what* changes over the course of a transformation), the change dynamics of transformation processes and emerging transformation pathways (i.e. *how* do transformation processes occur), and the drivers of transformation processes – particular towards sustainability (i.e. *by whom/how* are transformation processes supported). The research foci do not exclude but rather complement each other and are often studied together. We briefly illustrate these research foci by exploring how different research strands related to transformation research address them from their respective perspectives. This serves to discuss theoretical approaches and conceptual frameworks that are applied for a variety of topics (e.g. energy, mobility, climate change). The diverse applications of concepts and explanation models require careful translation between research strands (Redman 2014, Olsson et al. 2014). Transformation research cannot solely build on integration of different research fields, but also needs to recognise pluralism in ap-

proaches and knowledge to understand and support sustainability transformations in their complexity. This promotes learning, debate and critical reflections (Patterson 2016, Wittmayer and Hölscher 2016).

Firstly, transformation research is concerned with the **objects of transformation**, including questions about the specific contents of change processes: Where are transformations located? What is it that changes and to what degree, i.e. what are starting and end situations? How can the change be evaluated (in relation to a normative sustainability orientation)? Transformations are generally understood as a radical change of the identity of a specific system including its fundamental components and feedback mechanisms (Göpel et al. 2014, Jacob et al. 2015a). The definition of a specific system focus is critical when studying objects of transformation. Transformations span different sizes and scales in relation to a particular system focus (Göpel et al. 2014). The WBGU (2011), for example, relates its notion of a ‘great transformation’ to Polanyi’s (1944) analysis of comprehensive economic, technological, cultural and political change. The various research fields employ different system foci that often consist of more narrowly defined boundaries and societal sub-systems: while resilience and sustainability science research focus on social-ecological systems (which are usually located in specific geographic areas), transition studies largely focus on societal systems, such as socio-technical or socio-economic systems (Smith and Stirling 2010, Loorbach 2014). The system focus has implications on the system objects and subjects that are taken into consideration for analysing the starting and end situation of a transformation. For example, transition research defines an incumbent system in terms of a regime that consists of the dominant actors, structures, cultures and practices in a system (Rotmans and Loorbach 2010). The focus on smaller scale systems warrants ‘backcoupling’ of insights on the implications of transformation processes at these scales in relation to broader societal sustainability transformations (Wittmayer and Hölscher 2016).

Secondly, transformation research studies the **change dynamics of transformation processes** and explores **emerging transformation pathways**. Change dynamics are conditioned by the co-evolution of interdependent system elements that influence, reinforce or weaken each other (Grießhammer and Brohmann 2015, Rotmans and Loorbach 2010). Co-evolution marks processes of long-term, gradual change that are interrupted by short periods of rapid and radical change. This might result in tipping points, when system boundaries are crossed and a new system identity becomes established (Göpel 2014). Tipping points can threaten the survival of a system – e.g. when planetary and social boundaries are crossed (Scheffer 2009, Lenton et al. 2008, Steffen et al. 2015, Raworth 2012) – but they can also open up opportunities for overcoming lock-in and navigating desirable change (Loorbach 2014). The various research fields concerned with sustainability transformations develop and test different concepts, heuristics and models to generate insights about what processes, dynamics and system elements drive and hinder transformations. For example, the multi-level perspective (MLP) of transition research serves as a framework to analyse change in (socio-technical) systems as resulting from an interplay between three different levels: niche, regime and landscape (Geels and Schot 2007). Resilience scholars employ the adaptive cycle and the panarchy as heuristic models to analyse change dynamics over time and across scale (Holling und Gunderson 2002, Holling et al. 2002).

Thirdly, transformation research looks at the **drivers of transformation processes** to facilitate desirable transformations. Though transformations can in principle not be controlled, actors can influence them into desirable directions (Rotmans and Loorbach 2010, Grießhammer and Brohmann 2015). A variety of (individual and organisational) actors from different societal sectors (government, civil society, market and third sector) intentionally and unintentionally contribute to transformation processes by taking up different roles (Avelino and Wittmayer 2016, Fischer and Newig 2016). The initial focus in transformation research was on so-called frontrunners that develop innovations in niches, promote new visions and seek to destabilise incumbent structures and practices (Raven et al. 2010, Loorbach 2010, Olsson et al. 2006, WBGU 2011, Geels 2014). While ‘regime’ actors were commonly seen as reinforcing existing systems (Schuitmaker 2012), recently this focus was expanded to also consider the

roles of change-inclined ‘regime’ actors to connect emerging initiatives and novelties to existing networks, structures and practices (Apajalahti 2012, Späth et al. 2012, cf. Bauknecht et al. 2015). In this vein, Westley et al. (2013) and Bauknecht et al. (2015) identified different strategies, roles and abilities of actors to promote transformations. These might differ according to the phases of a transformation (Fath et al. 2015). Increasingly also the role of networks, partnerships and intermediaries is emphasised that pool resources for synergies and coordinate across sectors and scales (Olsson et al. 2014, Loorbach 2014, Frantzeskaki et al. 2014).

The coordination of activities of multiple interacting actors and networks is generally described as (transformation/transition) governance. Guiding principles for such governance include long-term and systemic perspectives, co-creation, reflexivity, flexibility and learning-by-doing (Loorbach et al. 2011, Grießhammer and Brohmann 2015). Examples of concrete governance frameworks for sustainability transformations include transition management and adaptive governance that are put forth by transitions and resilience scholars, respectively (Loorbach 2010, Frantzeskaki et al. 2012, Folke et al. 2005, Armitage et al. 2008). Other approaches are transformative environmental policy (Jacob et al. 2015b), change management (Doppelt 2009), innovations management (Grießhammer and Brohmann 2015) and strategic niche management (Raven et al. 2010). Critical voices on such governance emphasise the need to more explicitly take existing power structures into account (Shove and Walker 2007, Smith and Kern 2009, Hendriks 2009, Meadowcroft 2009, Voß et al. 2009, Kenis et al. 2016).

3 Methods of transformation research

In the following, we provide an overview of social science methods for transformation research (section 3.1.). Consequently, we discuss those research methods that have been applied in selected transformation research projects and their relation to goals and research foci, results and research approaches of transformation research (section 3.2.).

3.1 Overview of Methods

In this section we provide a non-exhaustive overview of social science methods for transformation research identified through the analysis of research projects and complemented by inputs from literature reviews, expert interviews and our expertise. We have grouped the methods into five categories focusing on their general purpose: For example, do the methods serve to collect data or to analyse data? Do the methods structure participatory research processes?

An overview of the methods per category can be found in Table 2, a more elaborate version of this table including a method description and an outline of its purpose can be found in Wittmayer and Hölscher (2017: 70-82).

Table 2: Overview of methods⁴

Method	Research approach	Research result	More information
Data generation – general			
Experiment	DA: X (classic)	CK: X (classic)	Atteslander 1984, van den Bosch 2010

⁴ In the table, we identify for each method the research approaches they relate to (descriptive-analytical and/or transformative) and what results they generate (conceptual and/or actionable knowledge). With regard to the research approaches and results we differentiate between: strong applicability (marked with **X**), applicability (marked with X) and limited applicability (marked with (X)).

Method	Research approach	Research result	More information
	T: X (transformation-oriented)	AK: X (transformation-oriented)	
Participant observation	DA: X T: X	CK: X	Gupta and Ferguson 1997, Schöne 2003, Illius 2003
Research diaries	DA: X T: (X)	CK: X	Bolger et al. 2003, Sheble and Wildemuth 2009
Data generation – interview			
Delphi method	DA: X	CK: X AK: (X)	Linstone and Turoff 2002, Müller et al. 2013a
Expert interview	DA: X	CK: X AK: (X)	Bogner et al. 2002, Lurtz et al. 2013 Rüede and Lurtz 2012, Rückert-John et al. 2013, 2015
Photo elicitation	DA: X T: X	CK: X AK: (X)	Harper 2002, Bignante 2010, Clark-Ibanez 2004
Q-method	DA: X	CK: X AK: (X)	Watts and Stenner 2005, Müller and Kals 2004
Data analysis – general			
Case study	DA: X	CK: X	Yin 2008, Gerring 2004, Flyvbjerg 2006
Constellation analysis	DA: X	CK: X AK: (X)	Kröger et al. 2012
Discourse analysis	DA: X	CK: X	Hajer 1995, Allolio-Näcke 2010
Grounded Theory	DA: X	CK: X	Charmaz 2006, Reichertz 2010
Institutional analysis	DA: X	CK: X AK: (X)	Moss and Nölting 2014
Literature analysis	DA: X	CK: X	Branley 2012; Bortz and Döring 2006
Meta-analysis	DA: X	CK: X	Glass 1976; Bortz and Döring 2006
Qualitative content analysis	DA: X	CK: X	Mayring 2000
Social innovation biographies	DA: X	CK: X	Butzin and Widmaier 2016, Butzin et al. 2013
System analysis	DA: X T: X (participat.)	CK: X AK: X (participat.)	Saravanan 2008, Rotmans and Loorbach 2009, Findeisen and Quade 1985, Maas 2011, Wittmayer et al. 2011
Data analysis – actor analysis			
Stakeholder- and actor analysis	DA: X	CK: X	Nölting and Daedlow 2012
Social network analysis	DA: X	CK: X	Rürup et al. 2015, Cantner and Graf 2006, Marin and Wellman 2011

Method	Research approach	Research result	More information
Stakeholder Mapping	DA: X	CK: X AK: (X)	Brighton 2004, Grimble and Wellard 1997, Rowley 1997
Participatory network analysis	DA: X T: X	CK: X AK: X	Debourdeau et al. 2012
Conflict analysis	DA: X	CK: X AK: X	Artner-Nehls et al. 2014, Artner-Nehls and Siebert 2013
Participatory Methods			
Action learning	DA: X T: X	CK: (X) AK: X	SIMPACT 2015b
Backcasting	DA: (X) T: X	CK: (X) AK: X	Quist and Vergragt 2006, Carlsson-Kanyamaa et al. 2008, Quist et al. 2011
Community of Practice	T: X	CK: X AK: X	Karner et al. 2011a, 2011b, 2013a, 2013b, 2015
Conservation theatre	T: X	CK: (X) AK: X	Heras and Tàbara 2016
Expert workshops	DA: X T: (X)	CK: X AK: (X)	SIMPACT 2015a
Focus group	DA: X	CK: X AK: (X)	Gibbs 1997, Pelz et al. 2004
Fuzzy Set	DA: X T: (X)	CK: X AK: X	Kok et al. 2014, Pedde et al. (under review)
Hackathons	T: X	CK: (X) AK: X	Briscoe and Mulligan 2014
Indicator lab	T: X	CK: (X) AK: X	SIMPACT 2015c
Modelling and simulation	DA: X	CK: X AK: X	Haxeltine et al. 2008; Holtz et al. 2015
Online Communities/ Knowledge Hubs	DA: X T: X	CK: (X) AK: X	Nørskov and Rask 2011 Preece et al. 2004
Scenario development	DA: X T: X	CK: X AK: X	Van Notten et al. 2003
Visioning	T: X	CK: (X) AK: X	Wiek and Iwaniec 2013, Davies et al. 2012
Participatory frameworks			
Real world laboratories (Living Labs)	T: X	CK: X AK: X	Schneidewind 2014; Nevens et al. 2013; Kieboom 2014
Transition Management	T: X	CK: X AK: X	Loorbach (2010), Wittmayer et al. (2014), Roorda et al. (2014)
Transdisciplinary Case Studies	T: X DA: (X)	CK: X AK: X	Burandt et al. 2003, Stauffacher et al. 2006

Method	Research approach	Research result	More information
Participatory Action Research	T: X	CK: X AK: X	Greenwood and Levin 2007, Palmer 2009

3.2 Analysis of applied methods in transformation research projects

3.2.1 Relation to goals and research foci of transformation research

In principle, each method bears the **potential** to contribute to the outlined goals of transformation research, namely to describe, analyse, explain, evaluate and support sustainability transformations. Yet, whether and how this potential is mobilised depends on the research focus and the actual application of the method. For example, a constellation analysis serves on the one hand to describe and explain a dominant constellation of a system. On the other hand, it can (also) support transformation processes by facilitating exchange processes between different actors. In the ELaN project⁵, the constellation analysis was applied as a facilitation technique to develop a shared problem framing, to achieve transparency on different problem perceptions and to formulate practical solutions in a specific case study (Kröger et al. 2012). Often, methods are used in **combination**, which allows the integration of different research goals and research foci.

All methods **serve to describe and explain transformations** and their processes and thus contribute to a better understanding of transformation processes, possible transformation pathways and drivers and solutions of desirable transformations towards sustainability. It depends on the specific problem focus, which methods are applied for what research foci. For example, a system analysis can be applied to analyse transformation processes and their dynamic but also to identify niche actors that can support sustainability transformations in practice. Data collection methods such as interviews, but also literature analysis are mainly used to develop a general overview on the existing knowledge base on a topic. The project “Soziale Innovation in Deutschland” [Social Innovation in Germany] combined literature analysis, interviews and the Delphi-method to review knowledge on social innovation in literature and practice and identify challenges and success factors (Lurtz et al. 2013, Müller et al. 2013a, 2013b, Kopf et al. 2015, Rüede and Lurtz 2012). Participatory methods and participatory frameworks are applied in more concrete contexts with a focus on obtaining a joint understanding with stakeholders on transformation processes that forms a basis for identifying transformation pathways and concrete solutions. In the InContext-project, transition management was implemented to develop a common problem definition with actors in specific communities (Wittmayer et al. 2013). Also here different methods were combined: For example, the initial problem analysis to describe and explain a specific starting situation builds on additional methods such as literature analysis, interviews and system analysis.

All analysed research projects also **seek to support sustainability transformations**, yet in very diverse – more or less explicit – ways. The kind of support includes amongst others the formulation of general guiding manuals or policy recommendations based on the ‘translation’ of scientific insights. For example, the project “Soziale Innovation in Deutschland” [social innovation in Germany] formulated support strategies for different types of social innovations based on a typology. Another kind of support results from the introduction of insights into the societal discourse through different types of events. Also the transdisciplinary development of concrete initiatives and projects is a form of support. The action research process in the InContext-project resulted in the opening of a local community centre. In the ELaN-project, workshops were organised to devise and implement pilot projects. The

⁵ “Entwicklung eines integrierten Landmanagements durch nachhaltige Wasser- und Stoffnutzung in Nordostdeutschland” [Development of integrated land management through sustainable use of water and resources in North-East-Germany].

Foodlinks-project established online communities and published Wikipedia and blog entries to disseminate the project's insights for the wider support of sustainability transformations (Galli and Brunori 2013, Karner et al. 2013a).

3.2.2 Contribution to results of transformation research

The results of transformation research encompass conceptual and actionable knowledge. The identified research methods show a strong tendency towards generating (at least) conceptual knowledge, which serves to contribute to a better understanding of transformation processes. Data collection and analysis methods primarily target conceptual knowledge. For example, the project "In Zukunft eine klimaverträgliche Gesellschaft: Multiplikatorenanalyse zur Untersuchung von transformierenden gesellschaftlichen Strategien" [A climate-resilient society in the future: multiplier analysis to study transformative societal strategies] used different forms of discourse analysis (e.g. media content analysis) to analyse public and scientific debates on the two-degree target to contain climate change. This resulted in conceptual knowledge on the amount of media coverage and scientific publications, dominant themes, frames and actors. Only few methods – such as Online Communities – are less explicitly oriented towards (also) generating conceptual knowledge. In principle such methods could contribute to data collection for conceptual knowledge, this would however require additional methods for data analysis to enable scientifically sound conclusions.

Participatory methods and participatory frameworks (e.g. transition management, living labs) generate both conceptual and actionable knowledge, while explicitly focusing on the latter. For example, participatory research processes often build on theoretical groundwork and discussions on the challenges and influencing factors in a specific context (e.g. through a participatory system analysis). These insights can be scientifically analysed, compared and abstracted. They also enable actors to weigh different options for actions and make informed decisions about concrete solutions. The ELaN-project, for example, encompassed interdisciplinary and transdisciplinary discussions between scientists and regional actors and generated next to conceptual knowledge also actionable knowledge that resulted in practical activities to support sustainability transformations

3.2.3 Relation to research approaches

Transformation research builds on both descriptive-analytical and transformative research approaches. The overview and analysis of methods shows that most methods are applied based on a descriptive-analytical research approach. This closely relates to the intended research goals and results. Projects building on a descriptive-analytical research approach seek to mainly generate conceptual knowledge to describe, explain and evaluate transformation processes. The translation into more actionable knowledge such as political recommendations is subordinate; the key focus is on feeding the research results back into scientific debates.

A transformative research approach targets primarily the support of sustainability transformations by developing concrete and context-specific solutions and actions. It builds on participatory methods and participatory frameworks or methods are implemented in a participatory mode. Regarding the latter, in the Foodlinks-project interviews were used to stimulate reflections of workshop participants, which might have repercussions on their actions. Transition management is a participatory method framework that combines different methods into subsequent process steps (e.g. system analysis, visioning, backcasting). Each process steps has a specific goal, like in the InContext-project: The system analysis served to generate a comprehensive and shared understanding of the problems in the local community, the visioning helped the participants to formulate a shared vision for the future of the community and the backcasting process connected that vision to the current situation to identify transformation pathways and actions (Wittmayer et al. 2011, 2014).

4 Discussion: implications for transformation research practice

The analysis of the methods employed in transformation research projects reveals several key reflection points relating to specific contributions of methods as well as gaps in the way methods are applied in transformation research practice. We need to bear in mind that depending on the goals for which a particular method is applied (only) certain potentials of that method are mobilised.

4.1 Establishing a sound knowledge basis

Methods to establish a sound knowledge base appear as central prerequisites in all research projects to generate a basic understanding of a problem at hand from which to further contribute to conceptual and/or actionable knowledge. Methods for data collection such as interviews and literature analyses represent traditional research methods and can be applied as basic social sciences tools for transformation research. They serve to establish a solid and comprehensive basis for studying and sharpening specific research questions and problems. For example, the project “Nachhaltiger Konsum durch soziale Innovation – Konzepte und Praxis” [sustainable consumption through social innovation – concepts and practice] conducted literature analyses at the outset of the research to develop a scientifically funded framework for systematically describing the heterogeneous field of social innovation for sustainable consumption (Rückert-John et al. 2013, 2015). Similarly, the project “Soziale Innovation in Deutschland” [social innovation in Germany] used literature review to systematically clarify the concept of social innovation due to heterogeneity and disagreement in literature and praxis (Rüede and Lurtz 2012). Both projects complemented their literature analysis with expert interviews to empirically ground their insights and make them practice-oriented. Expert interviews can additionally contribute to further narrow down the research focus, as experts can, for example, indicate what problem fields and initiatives have particular relevance in a specific context (Lurtz et al. 2013). While both methods can principally be employed independently from one another, their combination is considered useful to ensure a broad knowledge basis for further deeper-going research.

Projects based on a transformative approach use literature analysis and interviews as basic tools to obtain an encompassing picture on the starting situation and facilitate the development of solution options. For example, the ELaN-project analysed current strategies, institutional frameworks and actors (including their interests, problem views and actor constellations) in land and water management in the case studies (Nölting and Daedlow 2012, Kröger et al. 2012, Moss and Nölting 2014, Artner-Nehls et al. 2014). This also extends to the combination of data collection and analysis methods. For example, social network analysis helps to identify dominant actors and network structures to engage in participatory processes or to communicate with throughout (Sandström und Rova 2010).

4.2 Standardising methods and coupling of methods

Transformation research often couples different methods. Particularly methods for data collection (e.g. interviews) are combined with methods for data analysis (e.g. institutional analysis, stakeholder analysis). As described above, the ELaN-project coupled diverse methods such as interviews, literature analysis, constellation analysis, actor analysis and institutional analysis to establish an analytical understanding of the situations in the case studies. Particularly participatory methods and method frameworks seem to require such coupling to connect knowledge on starting situations, desirable directions for development and concrete opportunities for action. Individual, uncoupled methods are possibly insufficient for transformation research.

A central challenge for transformation research is therefore the further coupling of methods in suitable frameworks. These could possibly form functional groups of methods (Wiek 2016). The central use of such method frameworks is to combine methods of problem analysis with methods to develop solutions. This could be achieved through a standardisation of methods and method frameworks that shows the diverse functions and application fields of individual methods. The standardisation of methods and their functions might also reveal gaps both in terms of availability of methods and how they

are applied. For example, the support of sustainability transformations also requires methods of destruction, while currently research methods often focus on innovation and creation (Wittmayer and Hölscher 2016). Finally, standardisation also contributes to professionalise transformation research, boosts uptake of listed methods and method frameworks and joint learning.

Standardisation does not veil the diversity of methods, it rather serves to make it explicit. The guiding manual for transition management in urban contexts represents a specific example of standardisation, which has been translated into ten different languages to boost uptake of the transition management framework while emphasising the need for context sensitivity (Roorda et al. 2014).

4.3 Fostering transformative research approaches

The current dominance of descriptive-analytical research approaches demonstrates the outsider status of transformative research. Transformation research that seeks to contribute to sustainability transformations through actionable knowledge requires new and possible re-defined and re-discovered methods for transformative approaches. A promising direction represents the ‘discovery’ of for example the conservation theatre that invites participants to physically express and explore their feelings in relation to climate change (Heras and Tàbara 2016). Research methods for transformative approaches do not necessarily need to be newly developed, as there is already a wide array of potential methods (Wiek 2016). Rather, the potential of existing methods needs to be clarified (see also section 4.2.). Participatory research frameworks like transition management and living labs seem to provide good indications for transformative research approaches and processes. The involvement of actors in the research process is critical for the joint development of problem understandings and solution options. Also the combination of transformative and descriptive-analytical approaches bears many promises to substantiate projects and actions with comprehensive insights in a specific context (see section 4.1.).

Our conclusion that descriptive-analytical research approaches dominate in transformation research can also be related to some constraints to our selection of research projects. The availability of literature has been a central selection criterion that might have resulted in the exclusion of projects with more transformative approaches. Another issue might be the controversies girdling transformative research approaches (Stock 2014, Strohschneider 2014). This also influences the financing opportunities for transformative research that only get started – see for example the financing of living labs in Baden-Württemberg. Also institutional structures might be a reason for the rare application of transformative approaches and methods: both the training of researchers to employ them and career opportunities are limited.

4.4 Supporting critical reflections

The analysis of research methods and projects revealed little attention to reflexivity and quality of the research processes and their results (see Wittmayer and Hölscher 2017). For example, the existing project publications contain sparse information on the identified quality criteria (see section 2.2.) and lack critical reflection on what the implications of the results are on the goals of transformation research to study and support societal sustainability transformations. The latter is particularly problematic in light of the danger to dilute the transformation notion and not explicitly take existing power structures or potential negative externalities into account (see section 2.3.).

Especially transformative research processes require such critical reflections and explicit consideration of quality criteria to enhance the legitimacy and ensure transparency of research in influencing societal transformation processes. There is hence also a need for critical reflection on, for example, the role of researchers and research, on underlying normative assumptions and on the actors involved in formulating the problem statements. Some of the listed methods might serve such reflections, for example through personal reflections of the researchers (e.g. in research diaries) or in collaboration with the participants in participatory research processes.

The reasons for the lack of critical reflections can be diverse. One reason might be, similar to the lack of transformative research approaches, existing research funding that did not create sufficient space for reflections or a gap in training researchers on these issues.

5 Concluding remarks

The swift development of transformation research over the past years warrants a fundamental reflection on its goals, contents, research approaches and methods. Transformation research brings together a diversity of research strands, theoretical concepts and frameworks and opens up space for transdisciplinary research methods. Our paper contributes to the debate on transformation research by delineating it as a shared perspective on fundamental societal change processes towards sustainability and positioning it within the research landscape and related research strands. We defined the goals, results and research foci of transformation research and specified a number of cornerstones for transformation research including a set of quality criteria and different research approaches. We particularly sought to identify social science methods that are applied in transformation research projects and to analyse their contribution to the goals, research foci and intended results of transformation research as well as their relationship to the research approaches.

Next to our discussion of the specific contributions of methods as well as the identification of needs and gaps in the way methods are applied in transformation research practice, we also formulate five overarching discussion points for further advancing transformation research, which emerge from our study and have been identified during our expert workshop (Wittmayer and Hölscher 2016). Overall, the position of transformation research within the necessary societal learning processes for sustainability transformation needs to be fleshed out further. Such positioning relates to the contents and results of transformation research as well as its methods and the science system.

1. Further work on the definition of sustainability transformations is needed

To overcome the danger that transformation is used as a buzzword that loses its analytical and normative value, what ‘transformation’ precisely entails requires further definition, the identification of criteria to qualify transformative change, a concrete system focus as reference point and learning from stories and narratives of transformation.

2. Further structuring transformation research

While transformation research brings different research fields and topics into a joint conversation and might include a variety of results and impacts, there is a need to further structure potential outputs, outcomes and impacts associated with transformation research to strengthen the perspective while maintaining diversity in approaches and concepts.

3. Strengthening transformative research

While the foremost goals of transformation research are creating knowledge for sustainability transformation and achieving real-world impact, remaining issues and questions refer to how to adapt research approaches to specific goals as well as how to measure the (diffuse and potentially invisible) results.

4. Engaging in reflexivity

As knowledge is uncertain and limited, a central challenge for transformation research is to boost reflexivity regarding the research process and its results – to ask critical questions about the normativity inherent in approaching sustainability transformations as research object (as with any other research object), ensure transparency about the epistemological assumptions of the researchers and critically assess the research’s actual (intended and unintended) contribution to a societal sustainability transformation.

5. Transforming the science system

Transformation research challenges the difference between research (as practice) and science (as system), as a transformation of research practice needs to be complemented by transformation of the science system, for example by changing funding structures, quality criteria and integrating considerations of sustainability and transformation more broadly in academic curricula.

6 References

- Allolio-Näcke, L. (2010): Diskursanalyse – Bestandsaufnahme und interessierte Anfragen aus einer dichten Foucault. *FQS* 11(3), Art. 26.
- Apajalahti, E.-L. (2012): The role of large incumbent energy companies in energy system transition - The case of Finland's "coal coast". Paper präsentiert auf IST 2012 - International Conference on Sustainability Transitions. Lyngby, Denmark 29-31 August 2012.
- Armitage, D., Marschke, M. and Plummer, R. (2008): Adaptive co-management and the paradox of learning. *Glob Environ Change* 18: 86-98.
- Artner-Nehls, A., Röhricht, W.J.C., Siebert, R. and Zeidler, M. (2014): Interessen und Konfliktpotenziale bei einer geplanten Bewirtschaftung von Rieselfeldern in Berlin-Brandenburg durch Kurzumtriebsplantagen (KUP), ELaN Discussion Paper. ISBN 978-3-943679-15-1.
- Artner-Nehls, A., and Siebert, R. (2013): Akteurinnen und Akteure, Akzeptanz und Konfliktpotenziale im nachhaltigen Land- und Wassermanagement im Rahmen von ELaN, ELaN Discussion Paper. ISBN 978-3-943679-09-0.
- Atteslander, P. (1984): Methoden der empirischen Sozialforschung. Berlin: Walter de Gruyter: 190-210.
- Avelino, F. (2011): Power in Transition. Empowering Discourses on Sustainability Transitions. PhD Thesis: Erasmus University of Rotterdam.
- Avelino, F., and Wittmayer, J.M. (2016): Shifting Power Relations in Sustainability Transitions: A Multi-actor Perspective. *Journal of Environmental Policy & Planning*. DOI: 10.1080/1523908X.2015.1112259.
- Avelino, F., Wittmayer, J.M., Pel, B., Weaver, A., Dumitru, A., Haxeltine, A., Kemp, R., Jørgensen, M.S., Bauler, T., Ruijsink, S., and O'Riordan, T. (forthcoming): Transformative Social Innovation and (Dis)Empowerment: Towards a Heuristic. *Technological Forecasting and Social Change*.
- Bartels, K.P.R. (2012): The Actionable Researcher. Cultivating a Process-Oriented Methodology for Studying Administrative Practice. *Administrative Theory & Praxis* 34(3): 433-455.
- Bartels, K. and Wittmayer, J.M. (2014): Symposium Introduction: Usable Knowledge in Practice. What Action Research has to Offer to Critical Policy Studies. *Critical Policy Studies* 8(4): 397-406.
- Bauknecht, D., Brohmann, B. and Griebhammer, R. (2015): Transformationsstrategien und Models of Change für nachhaltigen gesellschaftlichen Wandel: Gesellschaftlicher Wandel als Mehrebenenansatz. Bericht des AP2, Dessau-Roßlau: Bundesumweltamt. <http://www.umweltbundesamt.de/publikationen/gesellschaftlicher-wandel-als-mehrebenenansatz>. Accessed: 01.03.2016.
- Bergmann, M., Brohmann, B., Hoffman, E., Loibl, M.C., Rehaag, R., Schramm, E. and Voß, J.P. (2005): Quality Criteria of Transdisciplinary Research. A Guide for the Formative Evaluation of Research Projects. Frankfurt: Institute for Social-Ecological Research GmbH. ISOE-Studientext, No. 13.
- Bergmann, M., Jahn, T., Knobloch, T., Krohn, W., Pohl, C. and Schramm, E. (2010): Methoden transdisziplinärer Forschung: Ein Überblick mit Anwendungsbeispielen. Frankfurt am Main: Campus Verlag.
- Bignante, E. (2010): The use of photo-elicitation in field research. Exploring Maasai representations and use of natural resources. *EchoGéo* 11. <http://echogeo.revues.org/11622>. Accessed: 01.03.2016.
- Bogner, A., Littig, B. and Menz, W. (2002): Das Experteninterview. Theory, Methode, Anwendung. Wiesbaden: VS Verlag für Sozialwissenschaften.
- Bolger, N., Davis, A. and Rafaeli, E. (2003): Diary methods: Capturing life as it is lived. *Annual review of psychology* 54(1): 579-616.
- Bortz, J. and Döring, N. (2006): Forschungsmethoden und Evaluation. Heidelberg: Springer Medizin Verlag.

- Bradbury, H. and Reason, P. (2003): Action Research. An Opportunity for Revitalizing Research Purpose and Practices. *Qualitative Social Work* 2(2): 155-175.
- Branley, D. (2012): Doing a literature Review. In: Seale, C. (ed.): *Researching Society and Culture*, London: SAGE Publications Ltd, Third Edition edition: 77-96.
- Briscoe, G. und Mulligan, C. (2014): Digital Innovation: The Hackathon Phenomenon. <https://qmro.qmul.ac.uk/xmlui/bitstream/handle/123456789/7682/Digital%20Innovation-%20The%20Hackathon%20Phenomenon.pdf?sequence=2>. Accessed: 01.03.2016.
- Burandt, S., Döscher, K., Fuisz, S.-K., Helgenberger, S. and Maly, L. (2003): Transdisziplinäre Fallstudien in Lüneburg. Beschreibung eines Entwicklungskonzepts hin zur angewandten Erweiterung des Curriculums an der Universität Lüneburg. https://www.google.nl/url?sa=t&rct=j&q=&esrc=s&source=web&cd=1&cad=rja&uact=8&ved=0ahUKEwjckeDpyaLLAh-WBJw8KHbiDAKMqFggcMAA&url=http%3A%2F%2Fwww.leuphana.de%2Finstitute%2Finfu%2Fpublikationen.html%3Fsorting_1%3DtypeClassification%26descending_1%3Dtrue&usg=AFQjCNH50hWeuHYImM-rCVXrTlij5VTWgaQ&bvm=bv.115339255,d.bGs. Accessed: 01.03.2016.
- Butzin, A. and Widmaier, B. (2016): Exploring territorial knowledge dynamics through innovation biographies. *Regional Studies*, 50(2): 220-232.
- Butzin, A., Rehfeld, D. and Widmaier, B. (Eds.) (2013): *Innovationsbiographien: räumliche und sektorale Dynamik*, Baden-Baden: Nomos Verl.-Ges. Innovation, Raum und Kultur, Bd. 1.
- Cantner, U. and Graf, H. (2006): The network of innovators in Jena: An application of social network analysis. *Research Policy*, 35(4): 463-480.
- Carlsson-Kanyamaa, A., Dreborga, K.H., Mollb, H.C. and Padovanc, D. (2008): Participative backcasting: A tool for involving stakeholders in local sustainability planning. *Futures* 40: 34-46.
- Cash, D., Clark, W., Alcock, F., Dickson, N., Eckley, N. and Jäger, J. (2002): Salience, Credibility, Legitimacy and Boundaries: Linking Research, Assessment and Decision Making. John F. Kennedy School of Government, Harvard University, Faculty Research Working Papers Series: RWP02-046.
- Clark-Ibáñez, M. (2004): Framing the social world with photo-elicitation interviews. *American behavioural Scientist*, 47(12): 1507-1527.
- Cole, S. (1983): The hierarchy of the sciences? *American Journal of Sociology*, 89: 111-139.
- Cook, S.D.N. and Wagenaar, H. (2012): Navigating the Eternally Unfolding Present: Toward an Epistemology of Practice. *The American Review of Public Administration*, 42(1): 3-38.
- Davies, A.R., Doyle, R. and Pape, J. (2012): Future visioning for sustainable household practices: spaces for sustainability learning? *Area*, 44(1): 54-60. DOI: 10.1111/j.1475-4762.2011.01054.x.
- Debourdeau, A. Baasch, S., Bar-On, H. and Umpfenbach, K. (2012): Case study Report - Empirical report. Deliverable 3.2. InContext: EU ENV.2010.4.2.3-1 grant agreement n° 265191. www.incontextfp7.eu/sites/default/files/D%203.2_Case%20Study%20Report%20Empirical%20Report%20-%20final_0.pdf. Accessed: 19.09.2015.
- Doppelt, B. (2009): *Leading Change toward Sustainability. A Change-Management Guide for Business, Government and Civil Society*. Sheffield: Greenleaf Publishing.
- Fath, B.D., C.A. Dean, and Katzmaier, H. (2015): Navigating the adaptive cycle: an approach to managing the resilience of social systems. *Ecology and Society* 20(20): 24. doi:10.5751/ES-07467-200224.
- Findeisen W. and Quade, E.S. (1985): The Methodology of Systems Analysis: An Introduction and Overview. In: Miser H.J. and Quade E.S. (Eds.) *Handbook of Systems Analysis: Overview of Uses, Procedures, Applications, and Practice*. New York: Elsevier Science Ltd.: 117-149.
- Finlay, L. (2002a): "Outing" the Researcher: The Provenance, Process and Practice of Reflexivity. *Qualitative Health Research*, 12(4): 531-545.
- Finlay, L. (2002b): Negotiating the swamp: the opportunity and challenge of reflexivity in research practice. *Qualitative Research*, 2(2): 209-230.

- Fischer, L.-B., Newig, J., 2016. Importance of actors and agency in sustainability transitions: a systematic exploration of the literature. *Sustainability* 8, 476.
- Flyvbjerg, B. (2006): Five Misunderstandings about Case-study Research. *Qualitative Inquiry*, 12:219-245.
- Flyvbjerg, B., Landman, T. and Schram, S. (2012): *Real Social Science*. Applied Phronesis. Cambridge: Cambridge University Press.
- Folke, C., Hahn, T., Olsson, P. and Norberg, J. (2005): Adaptive Governance of Social-Ecological Systems. *Annual Review of Environment and Resources*, 30(1): 441-473.
- Folke, C., Carpenter, S.R., Walker, B., Scheffer, M., Chapin, T. and Rockström, J. (2010): Resilience Thinking: Integrating Resilience, Adaptability and Transformability. *Ecology and Society*, 15(4): 20.
- Foxon, T., Reed, M.S. and Stringer, L.C. (2009): Governing long-term social-ecological change: What can the adaptive management and transition management approaches learn from each other? *Environmental Policy and Governance*, 19(1): 3-20.
- Franz, H.W., Hochgerner, J. and Howaldt, H. (Eds.) (2012): *Challenge Social Innovation: Potentials for Business, Social Entrepreneurship, Welfare and Civil Society*. Heidelberg: Springer.
- Frantzeskaki, N., Loorbach, D. and Meadowcroft, J. (2012): Governing societal transitions to sustainability. *International Journal of Sustainable Development*, 15(1): 19-36.
- Frantzeskaki, N., Wittmayer, J. and Loorbach, D. (2014): The role of partnerships in 'realizing' urban sustainability in Rotterdam's City Ports Area, the Netherlands. *Journal of Cleaner Production*, 65:406-417. doi: 10.1016/j.jclepro.2013.09.023.
- Frantzeskaki, N. and de Haan, H. (2009): Transitions: Two steps from theory to policy. *Futures*, 41(9):593-606.
- Funtowicz, S.O. and Ravetz, J.R. (1991): A New Scientific Methodology for Global Environmental Issues. In: Costanza, R. (Eds.) *Ecological Economics: The Science and Management of Sustainability*. New York: Columbia University Press: 137-152.
- Future Earth (2014): *Strategic Research Agenda 2014. Priorities for a global sustainability research strategy*. Future Earth – Research for global sustainability.
- Galli, F. and Brunori, G. (2013): Knowledge brokerage to promote sustainable food consumption and production: linking scientists, policymakers and civil society organizations. Deliverable D.3.1. Document developed in the framework of the FP7 project FOODLINKS (GA No. 265287). http://www.foodlinkscommunity.net/fileadmin/documents_organicresearch/foodlinks/publications/galli-brunori-d-3-1.pdf. Accessed: 30.11.2015.
- Geels, F.W. (2014): Regime resistance against low-carbon energy transitions: introducing politics and power in the multi-level perspective. *Theory, Culture & Society*, 31(5): 21-40.
- Geels, F.W. and Schot, J. (2007): Typology of sociotechnical transition pathways. *Research Policy*, 36: 399-417.
- Gerring, J. (2004): What is a case study and what is it good for? *American Political Science Review*, 98(2): 341-354.
- Gibbons, M., Limoges, H., Nowotny, H. Schwartzman, S., Scott, P. and Trow, M. (1994): *The New Production of Knowledge: The Dynamics of Science and Research in Contemporary Societies*. London: SAGE Publications.
- Gibbs, A. (1997): Focus Groups. *Social Research Update*, 19. <http://sru.soc.surrey.ac.uk/SRU19.html>. Accessed: 01.03.2016.
- Glass, G.V. (1976): Primary, Secondary, and Meta-Analysis of Research. *Educational Researcher*, 5(10): 3-8.
- Göpel, M. (2014): *Navigating a New Agenda. Questions and Answers on Paradigm Shifts and Transformational Change*. Wuppertal Institut für Klima, Umwelt und Energy GmbH.
- Greenwood, D.J. and Levin, M. (2007): *Introduction to Action Research. Social Research for Social Change*. Thousand Oaks: Sage, 2nd Edition.
- Grießhammer, R. and Brohmann, B. (2015): Wie Transformationen und gesellschaftliche Innovationen gelingen können. UFOPLAN-Vorhaben Transformationsstrategien und Models of Change für nachhaltigen gesellschaftlichen Wandel. Dessau-Roßlau: Umweltbundesamt. <https://www.umweltbundesamt.de/publikationen/wie-transformationen-gesellschaftliche-innovationen>. Accessed: 01.03.2016.
- Grimble, R. and Wellard, K. (1997): Stakeholder Methodologies in Natural Resource Management: a Review of Principles, Contexts, Experiences and Opportunities. *Agricultural Systems*, 55(2): 173-193.

- Grin, J., Rotmans, J. and Schot, J. (2010): *Transitions to Sustainable Development: New Directions in the Study of Long Term Transformative Change*. New York/Oxford: Routledge.
- Grunwald, A. (2015): Transformative Wissenschaft – eine neue Ordnung im Wissenschaftsbetrieb? *GAIA*, 24(1): 17-20.
- Gupta, A. and Ferguson, J. (1997): Discipline and Practice. The „Field“ as Site, Method, and Location in Anthropology. In: Gupta, A. and Ferguson, J. (Eds.): *Anthropological Locations. Boundaries and Grounds of a Field Science*. Berkeley: University of California Press: 1-46.
- Hajer, M.A. (1995): *The Politics of Environmental Discourse: Ecological Modernisation and the Policy Process*, Oxford: Clarendon Press.
- Harper, D. (2002): Talking about pictures: A case for photo elicitation. *Visual Studies*, 17(1): 13-26. DOI: 10.1080/14725860220137345.
- Haum, R. and Pilardeaux, B. (2014): Transformationsforschung: Szenen einer Reformdebatte, in: Rogall, H., H.-C. Binswanger, F. Ekardt, A. Grothe, W.-D. Hasenclever, I. Hauchler, M. Jänicke, K. Kollmann, N.V. Michaelis, H.G. Nutzinger, G. Scherhorn (Eds.): *2014/2015 Jahrbuch Nachhaltige Ökonomie: Die Energiewende als gesellschaftlicher Transformationsprozess*, Marburg: Metropolis-Verlag: 101-115.
- Haxeltine, A., Whitmarsh, L., Bergman, N., Rotmans, J., Schilperoord, M. and Köhler, J. (2008) 'A Conceptual Framework for transition modelling', *Int. J. Innovation and Sustainable Development*, Vol. 3, Nos. 1/2, pp.93–114.
- Haxeltine, A.; Avelino, F., Pel, B., Dumitru, A.; Kemp, R.; Longhurst, N. Chilvers, J. and Wittmayer, J. M. (2016) A framework for Transformative Social Innovation (TRANSIT Working Paper # 5), TRANSIT: EU SSH.2013.3.2-1 Grant agreement no: 613169
- Hendriks, C. (2009): Policy design without democracy? Making democratic sense of transition management. *Policy Sciences*, 42(4): 341-368.
- Heras, M., and Tàbara, J.D. (2016): Conservation Theatre: Mirroring Experiences and Performing Stories in Community Management of Natural Resources. *Society & Natural Resources*, 29(8): 948-964.
- Heyen, D.A. and Brohmann, B. (2017): Konzepte grundlegenden Wandels und seiner Gestaltung Richtung Nachhaltigkeit – ein Überblick über die aktuelle Transformationsliteratur. In: Rückert-John, J. and Schäfer, M. (Eds.): *Governance für eine Gesellschaftstransformation. Herausforderungen des Wandels in Richtung nachhaltige Entwicklung*, Wiesbaden: Springer Fachmedien: 69-86.
- Hoffmann, E., Siebenhüner, B., Beschorner, T. and Arnold, M. (2007): Gesellschaftliches Lernen und Nachhaltigkeit. Zur Einführung. In: Hoffmann, E., Siebenhüner, B., Beschorner, T., Arnold, M., Behrens, T., Barth, V. and Vogelpohl, K. (Eds.): *Gesellschaftliches Lernen und Nachhaltigkeit*. Metropolis: 11-32.
- Holling, C.S., and Gunderson, L.H. (2002): Resilience and adaptive cycles. In: Gunderson, L.H., and Holling, C.S. (eds.): *Panarchy: understanding transformations in human and natural systems*, Island: Washington DC: 25-62.
- Holling, C. S., Gunderson, L. and Ludwig, L. (2002): In Quest of a Theory of Adaptive Change. In: Gunderson, L.H. and Holling, C.S. (Eds.): *Panarchy: understanding transformations in human and natural systems*, Washington D.C.: Island: 3-24.
- Holtz, G., Alkemade, F., de Haan, F., Köhler, J., Trutnevyte, E., Luthe, T., Halbe, J., Papachristos, G., Chappin, E., Kwakkel, J., Ruutu, S. (2015) Prospects of modelling societal transitions: Position paper of an emerging community. *Environmental Innovation and Societal Transitions* 17, 41-58.
- Illius, B. (2003): Feldforschung. In: Fischer, H. and B. Beer (Eds.): *Ethnologie. Einführung und Überblick*. Berlin: Dietrich Reimer Verlag: 79-98.
- IPCC (2014): *Climate Change 2014: Impacts, Adaptation and Vulnerability*. IPCC Working Group II Contribution to AR5. Summary for Policymakers. Cambridge University Press: Cambridge.
- Jacob, K., Bär, H. and Graaf, L. (2015a): Was sind Transformationen? Begriffliche und theoretische Grundlagen zur Analyse von gesellschaftlichen Transformationen. Teilbericht 1 des Projektes „Nachhaltiges Deutschland 2030 bis 2050 – Wie wollen wir in Zukunft leben?“. Texte 60/2015, Umweltbundesamt: Dessau-Roßlau. http://www.umweltbundesamt.de/sites/default/files/medien/378/publikationen/texte_58_2015_nachhaltiges_deutschland_2030_bis_2050_teil_1_1.pdf. Accessed: 01.03.2016.

- Jacob, K., Bär, H. and Graaf, L. (2015b): Transformative Umweltpolitik – Der Beitrag der Umweltpolitik zu Prozessen gesellschaftlichen Wandels. Teilbericht 3 des Projektes „Nachhaltiges Deutschland 2030 bis 2050 – Wie wollen wir in Zukunft leben?“. Texte 60/2015, Umweltbundesamt: Dessau-Roßlau.
- Karner, S., Rohrer, H., Boch, B., Hoekstra, F. and Moschitz, H. (2011a): Knowledge Brokerage in Communities of Practice. Synthesis report on literature review. Draft version. Document developed in the framework of the FP7 project FOODLINKS (GA No. 265287). http://www.foodlinkscommunity.net/fileadmin/documents/Common-contents/publications/D2.1_Synthesis_report_DRAFT_uploadHP_March2012.pdf. Accessed: 30.11.2015.
- Karner, S., Hoekstra, F. and Moschitz, H. (2011b): A compilation of tools and methods for Knowledge Brokerage. Draft Version (updated June 2013). Document developed in the framework of the FP7 project FOODLINKS (GA No. 265287). <http://www.foodlinkscommunity.net/fileadmin/documents/Common-contents/publications/D23-Pool-of-Tools-and-methods-DRAFT-update-June2013.pdf>. Accessed: 30.11.2015.
- Karner, S., Boch, B. B., Hoekstra, F., Moschitz, H. and Thaler, A. (2013a): Knowledge Brokerage in Communities of Practice. Hands on recommendations. Document developed in the framework of the FP7 project FOODLINKS (GA No. 265287):. http://www.foodlinkscommunity.net/fileadmin/documents_organicresearch/foodlinks/publications/Foodlink-broschuere-knowledge-brokerage.pdf. Accessed: 30.11.2015.
- Karner, S., Hoekstra, F., Bock, B.B., Moschitz, H. and Thaler, A. (2013b): Synthesis Report on results from Monitoring and Evaluation. Deliverable D.7.1. Document developed in the framework of the FP7 project FOODLINKS (GA No. 265287). http://www.foodlinkscommunity.net/fileadmin/documents_organicresearch/foodlinks/publications/karner-et-al-d-7-1.pdf. Accessed: 30.11.2015.
- Karner, S., Bock, B.B., Hoekstra, F., Moschitz, H., Thaler, A. and Wiskerke, H. (2015): FOODLINKS: Building communities of practice for learning on sustainable food consumption and production. In: Martinuzzi, A. and Sedlacko, M. (Eds.): Knowledge Brokerage for Sustainable Development. Greenleaf Publishing: Sheffield.
- Kates, R.W., Clark, W.C., Corell, R., Hall, J.M., Jaeger, C.C., Lowe, I., McCarthy, J.J., Schellnhuber, H.J., Bolin, B., Dickson, N.M., Faucheux, S., Calloprn, G.C., Grübler, A., Huntley, B., Jäger, J., Jodha, N.S., Kaspersen, R.E., Mabogunje, A., Matson, P., Mooney, H., Moore III, B., O'Riordan, T. and Svedin, U. (2001): Sustainability Science. *SCIENCE*, 292: 641-642.
- Kenis, A., Bono, F. and Mathij, E. (2016): Unravelling the (post-)political in Transition Management: Interrogating Pathways towards Sustainable Change. *Journal of Environmental Policy & Planning*. Doi: 10.1080/1523908X.2016.1141672.
- Kieboom, M. (2014): Lab Matters: Challenging the practice of social innovation laboratories. Amsterdam: Kennisland. Licensed under CC-BY.
- Kok, K., Bärhund, I., Flörke, M., Holman, I., Gramberger, M., Sendzimir, J., Stuch, B. and Zellmer, K. (2014): European participatory scenario development: strengthening the link between stories and models. *Climatic Change*: 1-14.
- Kopf, H., Müller, S., Rüede, D., Lurtz, K. and Russo, P. (Eds.) (2015): Soziale Innovationen in Deutschland. Von der Idee zur gesellschaftlichen Wirkung. Springer e-book.
- Kröger, M., Rückert-John, J. and Schäfer, M. (2012): Wissensintegration im nachhaltigen Landmanagement. Inter- und transdisziplinäre Problembeschreibung im Projektverbund ELaN, ELaN Discussion Paper. ISBN 978-3-943679-05-2.
- Lang, D.J., Wiek, A., Bergmann, M., Stauffacher, M., Martens, P., Moll, P., Swilling, M. and Thomas, C.J. (2012): Transdisciplinary research in sustainability science: practice, principles, and challenges. *Sustainability Science* 7 (Supplement 1): 25-43.
- Lenton, T.M., Held, H., Kriegler, E., Hall, J.W., Lucht, W., Rahmstorf, S. and Schellnhuber, H.J. (2008): Tipping elements in the Earth's climate system. *PNAS*, 105(6): 1786-1793.
- Lincoln, Y.S. and Guba, E.G. (1985): *Naturalistic Inquiry*. Newbury Park, CA: Sage Publications.
- Linstone, H.A. and Turoff, M. (2002) (Eds.): *The Delphi Method: Techniques and Applications*. <http://is.njit.edu/pubs/delphibook/>.
- Loorbach, D. (2007): *Transition Management. New Mode of Governance for Sustainable Development*. Erasmus University, Rotterdam.
- Loorbach, D. (2010): *Transition Management for Sustainable Development: A Prescriptive, Complexity-Based Governance Framework*. *Governance*, 23(1): 161-183.

- Loorbach, D., Frantzeskaki, N., and Thissen, W.H. (2011): A transition research perspective on governance for sustainability. In: Jaeger, C.C., Tàbara, J.D. and Jäger, J. (Eds.): *European Research on sustainable development, Volume 1: Transformative Science Approaches for Sustainability*. Springer: 73-90.
- Loorbach, D. (2014): *To Transition! Governance Panarchy in the New Transformation*. Inaugural lecture. Rotterdam: Erasmus University of Rotterdam.
- Loorbach, D., Frantzeskaki, N., and Huffenreuter, L.R. (2015): Transition management: Taking stock from governance experimentation. *Journal of Corporate Citizenship*, 58: 48-66.
- Lurtz, K., Müller, S. and Rüede, D. (2013): *Social Innovations: Expert Opinions on the Status Quo and Future Directions*, Oestrich-Winkel: World Vision Center for Social Innovation. <http://www.ebs-init.de/app/download/7268123586/Lurtz%2C+M%C3%BCller%2C+Rueede+-+Social+Innovation+Experts+-+small.pdf?t=1360762856>. Accessed: 30.11.2015.
- Maas, S. (2011): *Making sense of complex systems. A systems analysis methodology for Urban Transition Management: the case of Ghent and its climate ambitions*, Master thesis Wageningen University.
- Malkki, L.H. (2007): Tradition and Improvisation in Ethnographic Field Research. In: Cerwonka, A. and Malkki, L.H. (Eds.): *Improvising Theory. Process and Temporality in Ethnographic Fieldwork*. Chicago and London: The University of Chicago Press: 162-187.
- Marin, A. and Wellman, B. (2011): Social network analysis: An introduction. In: Scott, J. and Carrington, P.J. (Eds.): *The SAGE Handbook of Social Network Analysis*. London: SAGE: 11-25.
- Markard, J., Raven, R. and Truffer, B. (2012): Sustainability transitions: An emerging field of research and its prospects, *Research Policy*, 41: 955-967.
- Martens, W.J.M. and Rotmans, J. (2005): *Transitions in a Globalising World*. Lisse: Swets & Zeitlinger.
- Mayring, P. (2000): Qualitative Inhaltsanalyse. *FQS*, 1(2): 20.
- McGowan, K.A., Westley, F., Fraser, E.D. G., Loring, P.A., Weathers, K.C., Avelino, F., Sendzimir, J., Roy, R. Chowdhury, and Moore, M.-L. (2014): The research journey: travels across the idiomatic and axiomatic toward a better understanding of complexity. *Ecology and Society*, 19(3): 37.
- Meadowcroft, J. (2009): What about the politics? Sustainable development, transition management, and long term energy transitions. *Policy Sciences*, 42(4): 323-340.
- Miller, T.R. (2013): Constructing sustainability science: emerging perspectives and research trajectories. *Sustainability Science*, 8: 279-293.
- Miller, T.R., Wiek, A., Sarewitz, D., Robinson, J., Olsson, L., Kriebel, D., and Loorbach, D. (2014): The future of sustainability science: a solutions-oriented research agenda. *Sustainability Science*, 9(2): 239-246.
- Moss, T. and Nölting, B. (Hgrs.) (2014): *Mehrschichtige Institutionenanalyse zum nachhaltigen Landmanagement. Chancen und Hemmnisse der Nutzung von gereinigtem Abwasser*, ELaN Discussion Paper. ISBN 978-3-943679-13-7.
- Müller, S., Rüede, D., Lurtz, K., Kopf, H. and Russo, P. (2013a): *Deutschland 2030: Herausforderungen als Chancen für Soziale Innovationen*, Oestrich-Winkel: World Vision Center for Social Innovation. <http://www.ebs-init.de/app/download/7253853686/Mueller%2C+Rueede%2C+Lurtz+-+Deutschland+2030.pdf?t=1360574699>. Accessed: 30.11.2015.
- Müller, S., Lurtz, K., Rüede, D., Kopf, H., Russo, P. (2013b): *Mechanismen Sozialer Innovationen I: Entstehung, Entwicklung und Verbreitung*, Oestrich-Winkel: World Vision Center for Social Innovation. <http://www.ebs-init.de/app/download/7233391586/Mueller+et+al+%282013%29+Mechanismen+Sozialer+Innovationen+I.pdf?t=1387273299>. Accessed: 30.11.2015.
- Müller, F.H. and Kals, E. (2004): Die Q-Methode. Ein innovatives Verfahren zur Erhebung subjektiver Einstellungen und Meinungen. *FQS*, 5(2): 34.
- Nevens, F., Frantzeskaki, N., Loorbach, D., and Gorissen, L. (2013): Urban Transition Labs: co-creating transformative action for sustainable cities. *Journal of Cleaner Production*, 50: 111-122.
- Nölting, B. and Daedlow, K. (2012): *Einblicke in die Akteurslandschaft zum Wasser- und Landmanagement in Brandenburg und Berlin. Am Beispiel der Stoffströme ‚geklärtes Abwasser‘ und ‚Magnesium-Ammonium-Phosphat-Dünger‘*, ELaN Discussion Paper. ISBN 978-3-943679-03-8.

- Nørskov, Sladjana V. & Rask, Morten (2011). Observation of Online Communities: A Discussion of Online and Offline Observer Roles in Studying Development, Cooperation and Coordination in an Open Source Software Environment [55 paragraphs]. *Forum Qualitative Sozialforschung / Forum: Qualitative Social Research*, 12(3), Art. 5.
- Nowotny, H., Scott, P., and Gibbons, M. (2003): 'Mode 2' Revisited: The New Production of Knowledge. *Minerva*, 41: 179-194.
- O'Riordan, T., and Le Quéré, C. (2013): Future Earth: a science agenda for sustainability and human prosperity. *British Academy Review*, 22: 30-34.
- Ober, S. and Paulick-Thiel, C. (2015): *Zivilgesellschaft beteiligen. Perspektiven einer integrativen Forschungs- und Innovationspolitik*. Berlin: Vereinigung Deutscher Wissenschaftler.
- Olsson, P., Gunderson, L.H., Carpenter, S.R., Ryan, P., Lebel, L., Folke, C. and Holling, C.S. (2006): Shooting the rapids: navigating transitions to adaptive governance of social-ecological systems. *Ecology and Society*, 11(1): 18.
- Olsson, P., Galaz, V. and Boonstra, W.J. (2014): Sustainability transformations: a resilience perspective. *Ecology and Society*, 19(4): 1.
- Palmer, V.J. (2009): Getting with the Act of Action Research. *FQS*, 10(3): 26.
- Patterson, J. (2016): How are questions of transformation and transition addressed in diverse literatures? Presentation at Transformation research workshop, Berlin, June 14, 2016.
- Patterson, J., Schulz, K., Vervoort, J., Adler, C., Hurlbert, M., van der Hel, S., Schmidt, A., Barau, A., Obani, P., Sethi, M., Hissen, N., Tebboth, M., Anderton, K., Börner, S. and Widerberg, O. (2015): Transformations towards sustainability. Emerging approaches, critical reflections, and a research agenda, Earth System Governance Working Paper No. 33, Lund and Amsterdam: Earth System Governance Project.
- Pedde, S., Kok, K., Onigkeit, J., Brown, C., Holman, I., and Harrison, P. (under review): Bridging uncertainty concepts across narratives and simulations in environmental scenarios. *Regional Environmental Change*.
- Pelz, C., Schmitt, A. and Meis, M. (2004): Knowledge Mapping als Methode zur Auswertung und Ergebnispräsentation von Fokusgruppen in der Markt- und Evaluationsforschung. *FQS*, 5(2): 35.
- Pereira, L., Karpouzoglou, T., Doshi, S. and Frantzeskaki, N. (2015): Organising a Safe Space for Navigating Social-Ecological Transformations to Sustainability. *Int. J. Environ. Res. Public Health*, 12(2015): 6027-6044. doi:10.3390/ijerph120606027.
- Pohl, C., Rist, S., Zimmermann, A., Fry, P., Gurung, G.S., Schneider, F., Speranza, C.I., Kiteme, B., Boillat, S., Serrano, E., Hirsch Hadorn, G., and Wiesmann, U. (2010): Researchers' roles in knowledge co-production: experience from sustainability research in Kenya, Switzerland, Bolivia and Nepal. *Science and Public Policy*, 37(4): 267-281.
- Polanyi, K. (1944): *The great transformation: Economic and political origins of our time*. New York: Rinehart.
- Preece, J., Abras, C. and Maloney-Krichmar D. (2004) 'Designing and evaluating online communities: research speaks to emerging practice', *Int. J. Web Based Communities*, Vol. 1, No. 1, pp. 2–18.
- Quist, J., Thissen, W. and Vergragt, P. (2011): The impact and spin-off of participatory backcasting: From vision to niche. *Technological Forecasting & Social Change*, 78: 883-897.
- Quist, J. and Vergragt, P. (2006): Past and future of backcasting: The shift to stakeholder participation and a proposal for a methodological framework. *Futures*, 38: 1027-1045.
- Raven, R., van den Bosch, S. and Weterings, R. (2010): Transitions and strategic niche management: towards a competence kit for practitioners. *Int. J. Technology Management*, 51(1): 57-74.
- Raworth, K. (2012): *A safe and just space for humanity. Can we live within the doughnut?* Oxfam Discussion Paper, <https://www.oxfam.org/sites/www.oxfam.org/files/dp-a-safe-and-just-space-for-humanity-130212-en.pdf>. Accessed: 09.05.2015.
- Redman, C.L. 2014. Should sustainability and resilience be combined or remain distinct pursuits? *Ecology and Society* 19(2): 37. Doi:10.5751/ES-06390-190237.
- Reichert, J. (2010): Abduction: The Logic of Discovery of Grounded Theory. *FQS*, 11(1): 13.
- Rohe, W. (2015): Vom Nutzen der Wissenschaft für die Gesellschaft. Eine Kritik zum Anspruch der transformativen Wissenschaft. *GAIA*, 24(3): 156-159.

- Roorda, C., Frantzeskaki, N., Loorbach, D., Van Steenberg, F. and Wittmayer, J. (2012): Transition Management In Urban Context – guidance manual, collaborative evaluation version. Rotterdam: Drift, Erasmus University Rotterdam.
- Roorda, C., Wittmayer, J., Henneman, P., Van Steenberg, F., Frantzeskaki, N. and Loorbach, D. (2014): Transition Management in the Urban Context. Guidance manual. Rotterdam: Drift, Erasmus University Rotterdam.
- Rotmans, J. (2005): Maatschappelijke innovatie tussen droom en werkelijkheid staat complexiteit, DRIFT, Erasmus University Rotterdam.
- Rotmans, J. and Loorbach, D. (2009): Complexity and Transition Management. *Journal of Industrial Ecology*, 13: 184-196.
- Rotmans, J. and Loorbach, D. (2010): Towards a Better Understanding of Transitions and Their Governance: A Systemic and Reflexive Approach. In: Grin, J., Rotmans, J., Schot, J. (Eds.): *Transitions to Sustainable Development. New Directions in the Study of Long Term Transformative Change*, New York/London: Routledge: 105-220.
- Rotmans, J., Kemp, R. and van Asselt, M. (2001): Emerald Article: More evolution than revolution: transition management in public policy. *Foresight*, 3(1): 15-31.
- Rowley, T.J. (1997): Moving beyond Dyadic Ties: A Network Theory of Stakeholder Influences. *The Academy of Management Review*, 22(4): 887-910.
- Rückert-John, J., Jaeger-Erben, M., Schäfer, M., Aderhold, J. and John, R. (2013): Soziale Innovationen für nachhaltigen Konsum. Kriterien zur Analyse und Systematisierung, Beiträge zur Sozialinnovation, Berlin: Institut für Sozialinnovationen e.V. <http://www.isinova.org/images/literatur/BzS11.pdf>. Accessed: 30.11.2015.
- Rückert-John, J., Jaeger-Erben, M., Schäfer, M., Scholl, G. and Gossen, M. (2015): Nachhaltiger Konsum durch soziale Innovationen – Konzepte und Praxis, Projektschlussbericht, Umweltbundesamt. <http://www.isinova.org/images/literatur/Schlussbericht%20Konsum.pdf>. Accessed: 30.11.2015.
- Rüede, D. and Lurtz, K. (2012): Mapping the various meanings of social innovation: Toward a differentiated understanding of an emerging concept, EBS Business School, Research Paper Series 12-03. <http://www.ebs-init.de/app/download/7609341786/Rueede%2C+Lurtz+-+Mapping+the+Various+Meanings+of+Social+Innovation.pdf?t=1387273161>. Accessed: 30.11.2015.
- Rürup, M., Röbbke, H., Emmerich, M. and Dunkake, I. (2015): Netzwerke im Bildungswesen. Wiesbaden: Springer Fachmedien.
- Sandström, A. and Rova, C. (2010): Adaptive Co-management Networks: a Comparative Analysis of Two Fishery Conservation Areas in Sweden. *Ecology and Society*, 15(3): 14.
- Saravanan V.S. (2008): A systems approach to unravel complex water management institutions. *Ecological Complexity*, 5: 202-215.
- Scheffer, M. (2009): *Critical Transitions in Nature and Society*. Princeton: Princeton University Press.
- Scholz, R.W. and Steiner, G. (2015a): The real type and ideal type of transdisciplinary processes: part I—theoretical foundations. *Sustainability Science* 10(4): 527-544.
- Schuitmaker, T.J. (2012): Identifying and unravelling persistent problems. *Technological Forecasting and Social Change*, 79: 1021-1031.
- Schwartz-Shea, P. (2006): Judging Quality: Evaluative Criteria and Epistemic Communities. In: Yanow, D. and Schwartz-Shea, P. (Eds.): *Interpretation and Method. Empirical Research Methods and the Interpretive Turn*. Armonk/London: M.E. Sharpe: 89-114.
- Schwartz-Shea, P. and Yahow, D. (2012): *Interpretive Research Design. Concepts and Processes*. New York and London: Routledge.
- Schneidewind, U. (2014): Urbane Reallabore – ein Blick in die aktuelle Forschungswerkstadt. *pnd/online (Planung neu denken)*, III/2014: 1-7.
- Schneidewind, U. (2015a): Für eine erweiterte Governance von Wissenschaft. Ein wissenschaftspolitischer Rückblick auf das Jahr 2014, *GAIA*. 24(1): 59-61.
- Schneidewind, U. (2015b): Verantwortung für die Gesellschaft. Wissenschaft in der Großen Transformation. *Politische Ökologie*, 33(140): 18-23.

- Schneidewind, U. and Singer-Brodowski, M. (2013): *Transformative Wissenschaft : Klimawandel im deutschen Wissenschafts- und Hochschulsystem*. Marburg: Metropolis.
- Schöne, H. (2003): Die teilnehmende Beobachtung als Datenerhebungsmethode in der Politikwissenschaft. *Methodologische Reflexion und Werkstatt*, FQS, 4(2): 20.
- Sheble, L. and Wildemuth, B. (2009): Research diaries DRAFT. In Wildemuth, B. (Eds.): *Applications of social research methods to questions in information and library science*, Santa Barbara: Libraries Unlimited: 211-221.
- Shove, E. and Walker, G. (2007): CAUTION! Transitions ahead: Politics, practice, and sustainable transition management. *Environment and Planning A*, 39(4):763-770.
- SIMPACT (2015a): Stakeholder Experiments. <http://www.simpact-project.eu/dialogue/experiments.htm>. Accessed: 30.11.2015.
- SIMPACT (2015b): Action learning Sets. <http://www.simpact-project.eu/dialogue/actionlearning.htm>. Accessed: 30.11.2015.
- SIMPACT (2015c): Indicator labs. <http://www.simpact-project.eu/dialogue/indicatorlabs.htm>. Accessed: 30.11.2015.
- Smith, A. and Kern, F. (2009): The transitions storyline in Dutch environmental policy. *Environmental Politics*, 18 (1): 78-98.
- Smith, A. and Stirling, A. (2010): The politics of social-ecological resilience and sustainable socio-technical transitions. *Ecology and Society*, 15(1): 11. DOI: <http://www.ecologyandsociety.org/vol15/iss1/art11/>.
- Späth, P., Radecki, A. von, and Rohrer, H. (2012): Can we get e-mobility without a transition? – Incumbents dominating discourse and institution building in the “Model Region” of Stuttgart, Germany. Paper präsentiert auf IST 2012 - International Conference on Sustainability Transitions. DTU Lyngby, Denmark 29-31 August 2012.
- Stauffacher, M., Walter, A., Lang, D., Wiek, A. and Scholz, R.W. (2006): Learning to research complex real-world problems from a functional socio-cultural constructivism perspective: The transdisciplinary case study approach. *International Journal of Sustainability in Higher Education*, 7(3): 252-275. DOI: 10.1108/14676370610677838.
- Steffen, W., Richardson, K., Rockström, J., Cornell, S.E., Fetzer, I., Bennett, E.M., Biggs, R., Carpenter, S.R., de Vries, W., de Wit, C.A., Folke, C., Gerten, D., Heinke, J., Mace, G.M., Persson, L.M., Ramanathan, V., Reyers, B. and Sörlin, S. (2015): Planetary Boundaries: Guiding human development on a changing planet. *Science*, 347(6223).
- Stirling, A. (2006): Precaution, foresight and sustainability: reflection and reflexivity in the governance of science and technology. In: Voß, J.P., Bauknecht, D. and Kemp, R. (Eds.): *Reflexive governance for sustainable development*. Cheltenham: Edward Elgar: 225-272.
- Stock, G. (2014): Bericht des Präsidenten auf dem „Leibniztag“ der BBAW am 28.06.2014, <http://www.bbaw.de/veranstaltungen/2014/juni/bericht-praesident-2014>.
- Strohschneider, P. (2014): Zur Politik der transformativen Wissenschaft. In: Brodacz, A., Hermann, D., Schmidt, R., Schulz, D. and Schulze Wessel, J. (Eds.): *Die Verfassung des Politischen*. Festschrift für Hans Vorländer, Berlin: 175-194.
- UNEP (2012): 21 Issues for the 21st Century: Result of the UNEP Foresight Process on Emerging Environmental Issues, United Nations Environment Programme (UNEP), Nairobi, Kenya: 1-56. http://www.unep.org/pdf/Foresight_Report-21_Issues_for_the_21st_Century.pdf. Accessed: 02.04.2014.
- Van den Bosch, S.J.M. (2010): Transition Experiments: Exploring societal changes towards sustainability. Erasmus University Rotterdam. <http://hdl.handle.net/1765/20714>.
- Van der Brugge, R. and van Raak, R. (2007): Facing the adaptive management challenge: Insights from transition management. *Ecology and Society* 12(2).
- Van Notten, P.W.F., Rotmans, J., van Asselt, M.B.A. and Rothman, D.S. (2003): An updated scenario typology. *Futures*, 35: 423-443.
- Von Wissel, C. (2015): Die Eigenlogik der Wissenschaft neu verhandeln. Implikationen einer transformativen Wissenschaft. *GAIA*, 24(3) :152–155.
- Voß, J.-P., Smith, A. and Grin, J. (2009): Designing long-term policy: Rethinking transition management. *Policy Sciences*, 42(4): 275-302.
- Walker, B.H. and Meyers, J.A. (2004): Thresholds in Ecological and Social-Ecological Systems: a Developing Database,

- Watts, S. and Stenner, P. (2005): Doing Q methodology: Theory, method and interpretation. *Qualitative Research in Psychology*, 2(1): 67-91.
- WBGU, German Advisory Council on Global Change (2011): *World in Transition – A Social Contract for Sustainability*, Berlin.
- Westley, F.R., Tjornbo, O., Schultz, L., Olsson, P., Folke, C., Crona, B. and Bodin, Ö. (2013): A Theory of Transformative Agency in Linked Social-Ecological Systems. *Ecology and Society*, 18(3): 27 doi:10.5751/ES-05072-180327.
- Wiek, A. (2016): Methods of transformational sustainability science. Presentation at Transformation research workshop, Berlin, June 14, 2016.
- Wiek, A. and Iwaniec, D. (2013): Quality criteria for visions and visioning in sustainability science. *Sustain Sci*, 9(4): 497-512. DOI 10.1007/s11625-013-0208-6 2013.
- Wiek, A. and Lang, D. (2016): Transformational Sustainability Research Methodology. In: Heinrichs, H., Martens, P., Michelsen, G. and Wiek, A. (Eds.): *Sustainability Science An Introduction*. Dordrecht: Springer: 31-41.
- Wiek, A., Ness, B., Schweizer-Ries, P., Band, F.S., and Farioli, F. (2012): From complex systems analysis to transformational change: a comparative appraisal of sustainability science projects. *Sustainability Science*, 7(Supplement 1): 5-24.
- Wittmayer, J.M. (2016) *Transition management, action research and actor roles: Understanding local sustainability transitions*. PhD-Thesis. Erasmus University Rotterdam.
- Wittmayer, J., van Steenbergen, F., Quist, J., Loorbach, D. and Hoogland, C. (2011a): *The Community Arena: A co-creation*
- Wittmayer, J., van Steenbergen, F., Beenakker, Y. and de Haan, C. (2011): *Systeemanalyse Rotterdam-Carnisse*. Conceptversie december 2011. Rotterdam: DRIFT, Erasmus University Rotterdam.
- Wittmayer, J., Van Steenbergen, F., Baasch, S., Feiner, G., Omann, I., Quist, J. and Loorbach, D. (2012): Pilot projects on a roll. Year 2 pilot specific reports. Deliverable 4.3. InContext: EU ENV.2010.4.2.3-1 grant agreement n° 265191. <http://www.incontext-fp7.eu/sites/default/files/Pilot%20projects%20on%20a%20roll%2C%20Year%20Two%20Status%20Report.pdf>. Accessed: 02.04.2014.
- Wittmayer, J., M. Mock, F. van Steenbergen, S. Baasch, I. Omann and Schöpke, N. (2013): Taking stock – Three years of addressing societal challenges on community level through action research Pilot specific synthesis report. Deliverable 4.5. InContext: EU ENV.2010.4.2.3-1 grant agreement n° 265191. http://www.incontext-fp7.eu/sites/default/files/D4.5%20-%20Taking%20Stock-final_0.pdf. Accessed: 02.04.2014.
- Wittmayer, J.M. and Schöpke, N. (2014): Action, Research and Participation: Roles of Researchers in Sustainability Transitions. *Sustainability Science*, 9(4): 483-496.
- Wittmayer, J.M., Schöpke, N., van Steenbergen, F. and Omann, I. (2014): Making sense of sustainability transitions locally. How action research contributes to addressing societal challenges. *Critical Policy Studies*. 8(4): 465-485.
- Wittmayer, J.M. and Hölscher, K. (2016): *Transformation Research: Goals, Contents, Methods*. Workshop Report. Drift 216.
- Wittmayer, J.M. and Hölscher, K. (2017): *Transformationsforschung – Definitionen, Ansätze, Methoden*. Dessau-Roßlau: Umweltbundesamt.
- Yanow, D. (2006a): Thinking Interpretively: Philosophical Presuppositions and the Human Sciences. In: Yanow, D. and Schwartz-Shea, P. (Eds.): *Interpretation and Method. Empirical Research Methods and the Interpretive Turn*. Armonk/London: M.E. Sharpe: 5-26.
- Yanow, D. (2006b): Neither rigorous nor objective? Interrogating criteria for knowledge claims in interpretive science. In Yanow, D. and Schwartz-Shea, P. (Eds.): *Interpretation and Method. Empirical Research Methods and the Interpretive Turn*. Armonk/London: M.E. Sharpe: 67-88.
- Yin, R.K. (2008): *Case Study Research: Design and Methods*. London: Sage Publications.